3.3 derivative rules and homework 2014-10-14 day 34

Product Rule

$$\frac{d}{dx}(fg) = f'g + fg'$$

note not the "order" the book uses ...

Quotient Rule

$$\frac{d}{dx}\left(\frac{f}{g}\right) = \frac{f'g - fg'}{g^2}$$

Power Rule

$$\frac{d}{dx}(x^n) = nx^{n-1}$$

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$\frac{d}{dx}(x^{21}) = 21x^{21-1} = 21x^{20}$

$\frac{d}{dx}(x^{10}) = 10x^{10-1} = 10x^{9}$

$\frac{d}{dx}(x^{2}) = 2x^{2-1} = 2x^{1} = 2x$

$\frac{d}{dx}(x^{1}) = 1x^{1-0} = 1x^{0} = 1$

$\frac{d}{dx}(x^{0}) = 0x^{-1} = 0$

$\frac{d}{dx}(?) = \frac{c}{x} = cx^{-1}$

$\frac{d}{dx}(x^{-1}) = -1x^{-1-1} = -x^{-2} = -\frac{1}{x^2}$

$\frac{d}{dx}(x^{-2}) = -2x^{-2-1} = -2x^{-3} = \frac{-2}{x^3}$

$\frac{d}{dx}(x^{-3}) = -3x^{-3-1} = -3x^{-4} = -3\frac{1}{x^4}$

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$$\frac{d}{dx}\left(x^{\frac{1}{2}}\right) = \frac{1}{2}x^{\frac{1}{2}-1} = \frac{1}{2}x^{-\frac{1}{2}} = \frac{1}{2\sqrt{x^1}}$$

$$\frac{d}{dx}\left(x^{\frac{1}{3}}\right) = \frac{1}{3}x^{\frac{1}{3}-1} = \frac{1}{3}x^{-\frac{2}{3}} = \frac{1}{3\sqrt[3]{x^2}}$$

$$\frac{d}{dx}\left(x^{\frac{2}{5}}\right) = \frac{2}{5}x^{\frac{2}{5}-1} = \frac{2}{5}x^{-\frac{3}{5}}$$

$$\frac{d}{dx}\left(x^{\pi}\right) = \pi x^{\pi-1}$$

Calc 1

Calc 2

Calc 3

Differential Equations

Real Analysis

advanced mathy calculus

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$\frac{d}{dx}(\pi^3) = 0$

but.... $\frac{d}{dx}(2^x) =$ idky

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$\frac{d}{dx}\left(\frac{5}{x^2}\right)$

$a^{-m} = \frac{1}{a^m}$

Way 1

$\frac{d}{dx}(5x^{-2}) = -10x^{-2-1} = -10x^{-3}$

$= \frac{-10}{x^3}$

Way 2

$\frac{d}{dx}\left(\frac{f}{g}\right)$

$\frac{d}{dx}\left(\frac{5}{x^2}\right) = \frac{f'g - fg'}{g^2}$

$f(x) = 5$

$f'(x) = 0$

$g(x) = x^2$

$g'(x) = 2x$

$= \frac{(0)(x^2) - (5)(2x)}{(x^2)^2}$

$= \frac{-10x}{x^4} = \frac{-10}{x^3}$

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3.3/11) $y = -3x^{-8} + 2\sqrt{x}$ $\frac{d}{dx}(\ )$

$y = -3x^{-8} + 2x^{1/2}$

$y = \frac{dy}{dx} = 24x^{-9} + x^{-\frac{1}{2}} = \frac{24}{x^9} + \frac{1}{\sqrt{x}}$

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3.3/17) $f(x)=(x^3+7x^2-8)(2x^{-3}+x^{-4})$

Way 1 $f(x)=2+x^{-1}+14x^{-1}+7x^{-2}-16x^{-3}-8x^{-4}$

$=2+15x^{-1}+7x^{-2}-16x^{-3}-8x^{-4}$

$=0-15x^{-2}-14x^{-3}+48x^{-4}+32x^{-5}$

Way 2 $f(x)=(x^3+7x^2-8)(2x^{-3}+x^{-4})$

"f" "g"

$f'(x)=f'g+fg'$

$=(3x^2+14x)(2x^{-3}+x^{-4})+(x^3+7x^2-8)(-6x^{-4}-4x^{-5})$

$6x^{-1}+3x^{-2}+28x^{-2}+14x^{-3}+-6x^{-1}-4x^{-2}$

$-42x^{-2}-28x^{-3}+48x^{-4}+32x^{-5}$

$-15x^{-2}-14x^{-3}+48x^{-4}+32x^{-5}$

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12) $y = 7x^{-6} - 5\sqrt{x}$

$= 7x^{-6} - 5x^{1/2}$

$y' = -42x^{-7} - \frac{5}{2}x^{-\frac{1}{2}}$

$= -\frac{42}{x^7} - \frac{5}{2\sqrt{x}}$

21) $y = \frac{1}{5x-3}$

$y'(x) = \frac{(0)(5x-3) - 1(5)}{(5x-3)^2}$

$= \frac{-5}{(5x-3)^2}$

$y'|_{x=1} = \frac{-5}{(5(1)-3)^2} = \boxed{\frac{-5}{4}}$

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$$\frac{d}{dx}\left(cf(x)\right) = c\frac{d}{dx}\left(f(x)\right)$$

$$\frac{d}{dx}\left(5x\right) = \frac{d}{dx}(5)\cdot x + 5\cdot\frac{d}{dx}(x)$$

$$= (0)\cdot x + 5(1) = 5$$

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if $x(t)$ gives us position at any time

$$\frac{dx}{dt} = \frac{d}{dt}(x) = \text{velocity}$$

$$\frac{d^2x}{dt^2} = \frac{d}{dx}(\text{velocity}) = \text{acceleration}$$

$$\frac{d^3x}{dt^3} = \frac{d}{dt}(\text{acceleration}) = \frac{d^2}{dt^2}(\text{velocity}) = \text{jerk}$$

$$\frac{d^4x}{dt^4} = \text{snap}$$

$$\frac{d^5x}{dt^5} = \text{crackle}$$

$$\frac{d^6}{dt^6} = \text{pop}$$